REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-78 are presently active; Claims 1-3, 6, 7, 21, 32, 38, 75, and 78 have been presently amended. No new matter has been added.

In the outstanding Office Action, Claim 21 was objected to. Claim 1 was provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claim 1 of U.S. Pat. Appl. No. 10/673,583. Claim 1 was provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claim 1 of U.S. Pat. Appl. No. 10/673,501. Claim 1 was provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claim 1 of U.S. Pat. Appl. No. 10/673,138. Claim 78 was rejected under 35 U.S.C. § 101 for being non-statutory. Claims 1-21, 29-30, 32-34, 37-58, 66-67, 69-71, and 74 were rejected under 35 U.S.C. § 102(e) as being anticipated by <u>Sonderman et al</u> (U.S. Pat. No. 6,802,045). Claims 22 and 59 we rejected under 35 U.S.C. § 103(c) as being unpatentable over <u>Sonderman et al</u> in view of <u>Yunemura et al</u> (IEEE Article "Heat Analysis on Insulated Metal Substrates"). Claims 23-28 and 60-65 were rejected under 35 U.S.C. § 103(a) as being unpatentable over <u>Sonderman et al</u> in view of <u>Chen</u> (U.S. Pat. No. 5,719,796). Claims 31, 36, 68, and 73 were rejected under 35 U.S.C. § 103(c) as being unpatentable over <u>Sonderman et al</u> in view of <u>Nikoonahad</u> (U.S. Pat. No. 6,812,045). Claims 35 and 72 were rejected under 35 U.S.C. § 103(c) as being unpatentable over <u>Sonderman et al</u> in view of <u>Fatke</u> (U.S. Pat. Appl. No. 10/472,436).

Regarding the claim objection, Claim 21 has been amended to depend from Claim 20. Thus, the claim objection has been overcome.

Regarding Claim 78, the specification defines that the computer readable medium can be volatile or non-volatile media or transmission media. This definition refers to storage

elements such as for example read-only-medium (i.e., non-volatile memory or magnetic disks) and random access memory (volatile memory). This definition refers to transmission media, which the Office Action associates with an "intangible product." However, M.P.E.P. § 2106 indicates that a claimed computer-readable medium encoded with a computer program is a computer element which defines structural and functional interrelationships between the computer program and the rest of the computer which permit the computer's functionality to be realized and is thus statutory. Recently the court in *Ex Parte Lundgren*, 76 USPQ2d, 1385 has set forth there is no judicially recognized separate "technological arts" test for determining whether claimed processes or methods constitute patentable subject matter. Rather, the court looks to see if the claimed process or method produces useful, concrete, and tangible results. In the present case, Claim 44 provides instructions for "inputting data relating to an actual process being performed by the semiconductor processing tool." These instructions can be encoded in a volatile or non-volatile media medium and can be broadcast over a network (i.e. a transmission media) connecting for example a central computer to the semiconductor processing tool. These instructions can be realized in for example a series of optically modulated pulses or a series of electrical signals, which produce useful, concrete, and tangible results by the information content of what is transferred from one computer to another. Thus, it is respectfully requested that the rejection to Claim 78 under 35 U.S.C. § 101 be removed.

M.P.E.P. § 2131 requires for anticipation that each and every feature of the clamed invention must be shown and requires for anticipation that the identical invention must be shown in as complete detail as is contained in the claim.

Claim 1 as clarified defines a method for analyzing a process performed by a semiconductor processing tool that: (1) inputs process data relating to an actual process being performed by the semiconductor processing tool, (2) inputs a first principles physical model

which includes a set of computer-encoded differential equations and which describes at least one of a basic physical or chemical attribute of the semiconductor processing tool, (3) performs a first principles simulation using the physical model to provide a first principles simulation result ***in accordance with the process data relating to the actual process being performed in order to simulate the actual process being performed,*** and (4) uses the first principles simulation result to control the actual process being performed by the semiconductor processing tool. (The numbers have been added for illustrative purposes only.)

While there is disclosure of various models (e.g., the device physics model 310, the process model 320, and the equipment model 330) in Sonderman et al, these models are not disclosed as first principles models. While Sonderman et al disclose that the models can be used to produce a theoretical semiconductor wafer, the produced theoretical semiconductor wafer is not disclosed as having been produced from a first principles model. Indeed, the use of a theory in general reduces the complexity of the process being modeled by assumptions that simplify the mathematics and allow a finite solution (i.e., an algebraic function) to be produces that closely mimics or "emulates" reality. Indeed, Sonderman et al disclose that:

> Turning now to FIG. 3, a block diagram depiction of one embodiment of the simulation environment 210 is illustrated. In one embodiment the simulation environment 210 comprises a device physics model 310, a process model 320, and an equipment model 330, which are interfaced with a simulator 340. The models 310, 320, 330 are capable of ***emulating*** the behavior of various components of a semiconductor manufacturing facility.[1] [emphasis added]

Moreover, in one example, Sonderman et al disclose models that are functional representations of the behavior of various components of a semiconductor manufacturing

[1] Sonderman et al, col. 5, lines 11-17.

facility, as depicted in equations 1 and 2 in Sonderman et al, and are not related to first principles.[2]

Besides the fact that Sonderman et al do not teach a first principles model including a set of computer-encoded differential equations, it was discussed that the feedback as depicted in Figure 1 of Sonderman et al between the metrology data analysis unit and the simulation environment 210 was feedback used in Sonderman et al for updating the manufacturing model. However, these updates result in the regeneration of "new" manufacturing recipes. As such, the "new" simulation performed in Sonderman et al is on a process that has already been performed.

To this point, please find below a series of recitations from Sonderman et al that illustrate this point. This series of recitations starts with a disclosure in Sonderman et al that discloses a feature of "feedback corrections during the manufacturing of semiconductor wafers." When viewed in the context of the entirety of the teachings in Sonderman et al, this feature of "feedback corrections during the manufacturing of semiconductor wafers" is seen to refer to corrections from run-to-run and not feedback corrections of an actual process being performed. Sonderman et al disclose that (with emphasis added):

> The simulation environment 210 also comprises a process control interface 350, which is an interface that allows communications between the simulation environment 210 and the process control environment 180. The process control interface 350 also allows the simulation environment 210 to receive manufacturing data from the manufacturing environment 170, which can be used by the simulation environment 210 ***to perform feedback corrections during the manufacturing of semiconductor wafers***. Col. 5, lines 18-26.
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> In one embodiment, the computer system 130 sends control input signals, or manufacturing parameters, on the line 123 to the first and second machine interfaces 115a, 115b. The computer system 130 employs a manufacturing model 140 to generate the control input signals on the line 123. In one embodiment, the manufacturing model 140 contains ***a manufacturing recipe*** that determines a plurality of control input parameters that are sent on the line 123. Col. 4, lines 10-17.

[2] Sonderman et al, col. 9, lines 12-51.

> Once the system 100 performs the process simulation function, the system 100 performs an interfacing function, which facilitates interfacing of the simulation data with the process control environment 180 (block 430). The process control environment 180 can utilize the simulation data in order to modify or define manufacturing control parameters that control the actual processing steps performed by the system 100. ***Once the system 100 interfaces the simulation data*** with the process control environment 180, the system 100 ***then performs*** a manufacturing process ***based upon the manufacturing parameters defined by the process control environment*** 180 (block 440). Col. 6, lines 35-46.
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> Once the system 100 validates the defined models, the system 100 acquires data to operate the defined models (block 630). In one embodiment, the system 100 acquires data from the computer system 130 in order to operate the defined models. The system 100 then populates the defined models with the data acquired by the system 100 for operation of the models (block 640). In other words, the system 100 sends operation data, control parameter data, simulation data, and the like, to the defined models so that the defined models can perform a simulation ***as if an actual manufacturing process were being performed.*** Col. 7, lines 8-20.
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> Turning now to FIG. 8, a simplified process control system block diagram is illustrated. The controller 810 controls a process 820 that is performed on a silicon wafer. The input to the controller on a line 805 is denoted by the term X_{Ti}, which represents a target performance of the processed semiconductor wafer (S_i). ***Once a particular silicon wafer, S_i, is processed,*** metrology results 830 will define the actual performance of the processed semiconductor wafer S_i, which is denoted by the term X_{Ai}. The ***actual performance factor, X_{Ai} is fed back*** into the line 805 which is sent to the controller for further adjustments. Col. 9, lines 1-11.

Hence, it is respectfully submitted that Sonderman et al disclose a process feedback from run-to-run. This is seen by the feedback of a realized performance factor once a particular silicon wafer is processed, and the utilization of this data to produce through the manufacturing model 140 a "new" process recipe from this historical data to predict future simulation results for further runs.

Thus, when taken as a whole, the teachings of Sonderman et al do not disclose or suggest performing first principles simulation using a physical model to provide a virtual sensor measurement in accordance with the process data relating to the actual process being

performed in order to simulate the actual process being performed, as defined in the independent claims.

Similar to the simulation results in Sonderman et al, Kee et al (U.S. Pat. No. 5,583,780) disclose the use of a first principles physical model ***upfront*** to produce a model of a rapid thermal processing (RTP) reactor.[3] As disclosed in Kee et al:

> ***once a particular thermal process has been modeled for a particular set of control parameters***, the device may ***then*** be used to automatically obtain the necessary control parameters to achieve a desired result.[4] [emphasis added]
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> * * * *
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> As more fully described below, the modeling apparatus can be used ***to first model the spectral radiation transport*** in the RTP reactor 201 and ***then to receive a prescribed wafer time-dependent temperature profile*** and provide the necessary time-dependent lamp intensity control to achieve the proscribed profile.[5]

Kee et al describe from col. 11, line 14, to col. 12, line 33, describes the development of a modeling apparatus therein by (1) the input of data concerning the rapid thermal processor (not process data from an actual anneal), (2) model simulation, and (3) experimental comparison and model validation.

Indeed, in col. 12, lines 19-33 of Kee et al, the model results obtained in Kee et al are corroborated by comparison to actual data in order to develop the "confidence to predict" effects of various approximations in the radiation transport. Thus, initial data used in the development of the model result in Kee et al is ***not process data from an actual process being performed***. Rather, in Kee et al, the actual data is used in the experimental comparison and model validation steps disclosed therein.

Accordingly, there is no disclosure, suggestion, or motivation in Sonderman et al or Kee et al to input process data relating to an actual process being performed by the semiconductor processing tool and (2) perform a first principles simulation using the physical

[3] Kee et al was cited in related application U.S. Serial No. 10/673,506.
[4] Kee et al, col. 4, lines 33-36.
[5] Id,, col. 10, lines 41-45.

model to provide a virtual sensor measurement in accordance with the process data relating to the actual process being performed in order to simulate the actual process being performed, as defined in the independent claims.

Moreover, the examiner's attention is directed to Jain et al, "Mathematic-Physical Engine: Parallel Processing for Modeling Simulation of Physical Phenomena" cited but not applied by the U.S. Patent and Trademark Office. Jain et al "proposes" a parallel processing ***concept*** for the solution of physical phenomena described by partial differential equations. Jain et al detail at page 367 that goals of a specific Mathematic-Physical Engine (MPE) may include: model verification, response visualization, event verification, detection of small events, model compaction simplification, optimization of parameters and inputs, feasibility determinations. This list does not propose the use of a MPE for process control. Moreover, even the "dedicated" MPE of Jain et al is also a conceptual tool envisioned by Jain et al to be realizable through the hardware development of a "stacked wafer" processor architecture. The MPE of Jain et al is only a concept tool. As such, Jain et al provide no basis upon which one of ordinary skill in the art would have any reasonable expectation of success that the proposed MPEs could provide process control.

Thus, it is respectfully submitted that independent Claims 1, 38, 75, and 78 and the claims dependent therefrom patentably define over Sonderman et al and the remaining references.

Finally, regarding the provisional double-patenting rejection, Applicants submit that a terminal disclaimer can be filed, if the claims in the present application and the claims in the co-pending Application Nos. 10/673,583, 10/673,501, and 10/673,138 remain obvious in view of each other at the time of allowance of either of these applications. Indeed, M.P.E.P. § 804.02 IV states that, prior to issuance, it is necessary to disclaim each one of the double patenting references applied. Hence, Applicants respectfully request that the examiner

patenting references applied. Hence, Applicants respectfully request that the examiner contact the undersigned should the present arguments be accepted and should the case be otherwise in a condition for allowance. At that time, a terminal disclaimer can be supplied to expedite issuance of this case.

Consequently, in view of the present amendment and in light of the above discussions, the outstanding grounds for rejection are believed to have been overcome. The application as amended herewith is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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